"It is in humility that we build the future of the world"

IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI; PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org
United Nations Educational, Scientific and Cultural Organization

ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27

DOI: http://doi.org/10.5281/zenodo.5596613

# Habitat selection by Black Headed Ibis (*Threskiornis melanocephalus*) and Red Naped Ibis (*Pseudibis papillosa*) in the rural areas of district Jhajjar, Haryana, INDIA

Anjali & Sarita Rana

Department of Zoology, Institute of Integrated and Honours Studies, Kurukshetra University, Kurukshetra, Haryana 136119, INDIA

anjalisonijbb@gmail.com, saritarana20@gmail.com

**ABSTRACT:**

Habitat is an immense array of environment which provides food, water, space and shelter to a species. To fulfill these necessary requirements different bird species were found in the different types of habitats known as their preferred habitat and selection this preferred habitat in the birds vary seasonally depending upon their feeding guilds. The present study was conducted to investigate the most preferred habitat selected by Black Headed Ibis (*Threskiornis melanocephalus*) and Red Naped Ibis (*Pseudibis papillosa*) in the rural areas of district Jhajjar, Haryana from october 2020 to march 2021. To know about the habitat selection of both the Ibis species, spatial and landscape sampling were done in the study sites. A total of 48 spottings were observed for both the Ibis species during the study period in the three different habitats namely wetland, open-dry land and agricultural land. Black Headed Ibis was found to be maximum in wetland (60.41%) followed by agricultural land (22.91%) and open-dry land (16.66%). However Red Naped Ibis was spotted maximum in the agricultural land area (50%) followed by open-dry land (41.66%) and wetland (8.33%). The findings of this study suggested that the as the most preferred habitat of Black Headed Ibis was found to be wetland areas, while of Red Naped Ibis is agricultural land areas as having the maximum amount of food present in these areas and by conserving their habitat; these species will also be conserved.

**Key words-** Black Headed Ibis, Red Naped Ibis, Preferred habitat, Spatial sampling, Landscape sampling, Wetland, Agricultural land, Open-dry land.

## INTRODUCTION

Black Headed Ibis and Red Naped Ibis are the medium sized wading bird species (1,2) which belongs to order Pelecaniformes and family Threskiornithidae (3,4,5). Both of them can recognized easily from other wading birds by their beak which is probing typed and curved downwardly (6). Black Headed Ibis, also known as Oriental White Ibis is categorized as "Near Threatened" in IUCN Red List (5). The adult bird is completely white in color with contrasting black head and legs and an orange colored patch below its wings (1). While Red Naped Ibis commonly known as Black Ibis is considered as "Least Concerned" by IUCN red list (5). The adult body is completely dark brown with contrasting brick red colored legs and a most prominent red colored triangular patch on its square shaped head, absent in its juvenile. The subordinate feathers of their wings are darker with shiny blue in color and marked with white patch (1,7).

Habitat is a vast array of environment in which a species can gather its food, water, space and shelter (8) and on the basis of the fulfillment of these requirements different birds have different types of habitats known as their preferred habitat. The selection of these preferred habitats by the birds vary seasonally depending upon their feeding guilds (9). Black Headed Ibis is the most widely distributed all over India, Bangladesh, Sri Lanka, China, Pakistan , Nepal, Myanmar and Cambodia (1,10,11,12), while Red Naped Ibis is distributed throughout the sub continents of India, Burma Thailand, Vietnam, Nepal, Pakistan and Western China, but is the native species of India, Nepal and Pakistan (13).

As both the bird species are waders; so, principally both are aquatic but the most preferred habitat of Black Headed Ibis includes include wetlands, lagoons, freshwater pond, riverine lakes, paddies, swamps, marshlands and salty marshes. However, Red Naped Ibis most oftenly

"It is in humility that we build the future of the world"
IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI: PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org
United Nations Educational, Scientific and Cultural Organization
ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27
DOI: http://doi.org/10.5281/zenodo.5596613

found in the open dry zones as well as the shallow water habitat and agricultural land (2,14,15). Both the species shows nesting and roosting near wetland areas (2,16), on the top of trees and bushes, like *Acacia*, *Prosopis* and *Ficus* (2, 17). Black Headed Ibis shows roosting in colonies, which is simply an aggregation of the individuals of more than two species and spending their day and night resting time together. These roosting sites may be same or may be different ranges from agricultural land, highly-populated area and different types of natural as well as artificial wetlands (16,18,19,20,21). But the Red Naped Ibis doesn't shows rosting or nesting in colonies and always tends to form one nest per tree (17). Therefore the aim of the present study was to assess the groundwork information regarding the habitat selected by the Black Headed Ibis and Red Naped Ibis in the three different rural areas of district Jhajjar. Preferred habitat has a vital impact on the population size, feeding efficiency, nesting as well as the conservation of the bird species. So, the study presents a scientific and precise baseline information for future research to better understand the habitat selected by Black Headed Ibis and Red Naped Ibis that will be helpful in the conservation and ultimately provide conservations measures that will prevent the conversion of wetlands or the ponds used by the wading birds species into a source of economy which has also become a potential threat.

## MATERIAL AND METHODS

### STUDY AREA

The current study was carried out in the three different rural areas of district Jhajjar of Haryana named as Dighal, Gochhi and Chhochhi.. The district Jhajjar is located in the mid-Eastern part of Haryana and lies in between latitude 28° 36' N, and longitude 76° 39' E. It is divided into 4 subdivisions: These are named as Jhajjar, Bahadurgarh, Badli and Beri. District Jhajjar lies at an elevation of 720 ft (220m) above the sea level and covers 1,834 square kilometers total areas of the state, out of which 670 square kilometers area is devoted in agricultural land area. The climatic conditions of district remain arid in summers with intense hot environment and cold in winters. 577 mm annual rainfall occurs in this region out of which near bout 75% occurs in the monsoon period (from late June to August). The only perennial river that touches the eastern part of this district is Yamuna, but the water requirement of the district is fulfilled by Sahibi river, and this is seasonal in nature. Dighal is located at 28° 44' N latitude and 76° 36' E longitude; and it covers 30.57 $km^2$ geographical area. As this area is surrounded by a number of wetlands as well as lakes and comes under the route of a number of migratory birds, so mainly known for its importance of bird watching and making this area a potential Important Bird Area (IBA). Village Chhochhi lies at 28.7264° N Latitude and 76.6756° E Longitude, situated in Tehsil Beri of district Jhajjar and covers 5.44 $km^2$ geographical area. Village Gochhi lies at 28.7330° N Latitude and 76.5965° E Longitude and lies at 720ft (222m) elevation above the sea level.

## METHODOLOGY

To know the habitat selected by both Ibis species, day time survey without rain and fog was done at the study sites by crossing many types of microhabitats like agriculture crop field, marshland, Scrubland, irrigation channel, seasonal as well as permanent wetlands, grazing area. **Both spatial sampling and landscape sampling was done.** In spatial sampling on each and every sighting of both the Ibis their GPS coordinates were measured by

"It is in humility that we build the future of the world"
IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI: PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org
United Nations Educational, Scientific and Cultural Organization
ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27
DOI: http://doi.org/10.5281/zenodo.5596613

using a hand-held GPS device and the type of microhabitat was also noted (Choudhury, 2018). To differentiate landscape structure and vegetation cover categorical map, while for the probability of occurrence of both the Ibis species distribution map was prepared by using GIS (Geographic Information System software) ArcView software (22,23).

Landscape Sampling was used to know about the characteristics of the selected habitat by both the Ibis species. Landscape sampling will be done at two levels- macro-habitat level in which basically the type of habitat either it is scrubland, grassland, woodland or agricultural land identified visually. However at microhabitat level, basically the type of vegetation found in that area was calculated, by using the circular plot method (24,25) which is centered on the location of birds sighted. The data on a number of variables like the type of the tree species and shrub species was also calculated.

## RESULTS

Throughout the study period, a total number of 48 spotting were recorded for both the Ibis species and all these sightings were represented in the figure 3, 4 and 5. Figure 2 represents the the land cover map of district Jhajjar, in which the complete area seems to be divided into four different habitat represented by four different colors namely wetland by blue color, open-dry land by pale yellow color, agricultural land by green color and urban land by orange color. All along with that the three different study sites namely Gochhi, Dighal and Chhochhi were also represented in the map by three different colors which can be seen in figure-2.

Figure 3 represents the land cover map of village Dighal showing the sightings of Black Headed Ibis and Red Naped Ibis which is represented by white and black circles. Similarly figure 4 and 5 shows the different spotting of Black Headed Ibis and Red Naped Ibis in village Chhochhi and Gochhi. By overall outcome of the figure 3,4 and 5 represents that the Black Headed Ibis was found to be dominant in wetland habitat (60.41%) followed by agricultural land area (22.91%) and rarely in open dry land area (16.66%); while Red Naped Ibis dominated the agricultural land area (50%) closely followed by open-dry land (41.66%) and then wetland habitat (08.33%).

Figure 6 and 7 represents the Black Headed Ibis spotted in wetland and agricultural land area, while figure 8 and 9 represents the sighting of Red Naped Ibis in Agricultural land and open dry land habitat. However table 1 represents the most significant vegetation found in and around habitat in which both the ibis species were found. Vegetation found nearby wetlands includes water hyacinth (*Eichhornia*), eelgrass (*Vallisneria*), water thyme (*Hydrilla*), neem (*Azadirachta indica*), kikar (*Vachellia nilotica*), blue gum or safeda (*Eucalyptus globules*), peepal (*Ficus religosa*), sarkanda (*Saccharum bengalense*), Akh (*Calotropis procera*), bhang (*Cannabis sativa*), devil's snare (*Datura stramonium*) and babool (*Acacia nilotica*) were noticed, while in the agricultural land area wheat (*Triticum aestivum*), Sugarcane (*Saccharum officinarum*), mustard (*Brassica*), guvava (*Psidium guajava*), lemon (*Citrus limon*), peepal (*Ficus religosa*), neem (*Azadirachta indica*), kikar (*Vachellia nilotica*), blue gum or safeda (*Eucalyptus globules*) and babool (*Acacia nilotica*) contributes to the dominant vegetation. But in the open-dry land near the wetlands and agricultural land sarkanda (*Saccharum bengalense*), Akh (*Calotropis procera*), devil's snare (*Datura stramonium*), congress grass (*Parthenium hysterophorous*), indian doab

"It is in humility that we build the future of the world"
IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI; PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org
United Nations Educational, Scientific and Cultural Organization
ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27
DOI: http://doi.org/10.5281/zenodo.5596613

(*Cynodon dactylon*), blue gum or safeda (*Eucalyptus globules*) and babool (*Acacia nilotica*) were found to be dominant species of trees.

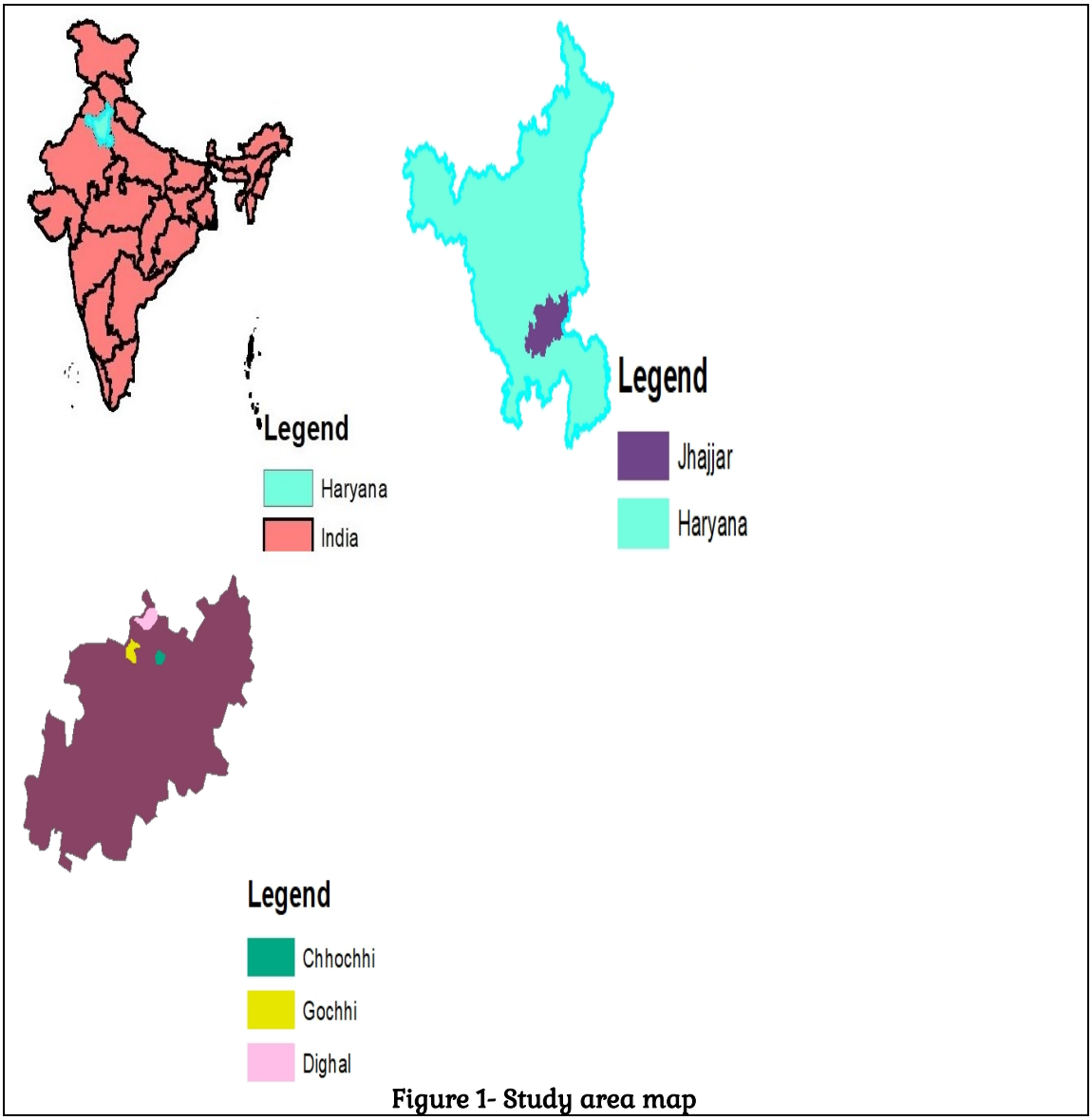


**Figure 1- Study area map**

"It is in humility that we build the future of the world"
IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI; PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org
United Nations Educational, Scientific and Cultural Organization
ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27
DOI: http://doi.org/10.5281/zenodo.5596613

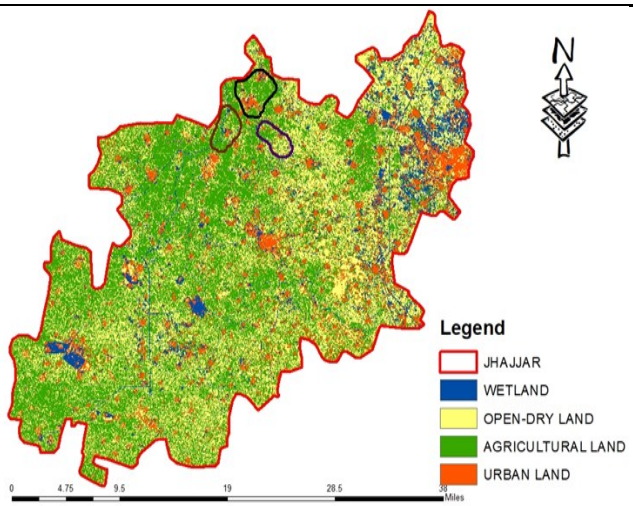


Figure 2- Land cover map of district Jhajjar showing three different study sites.

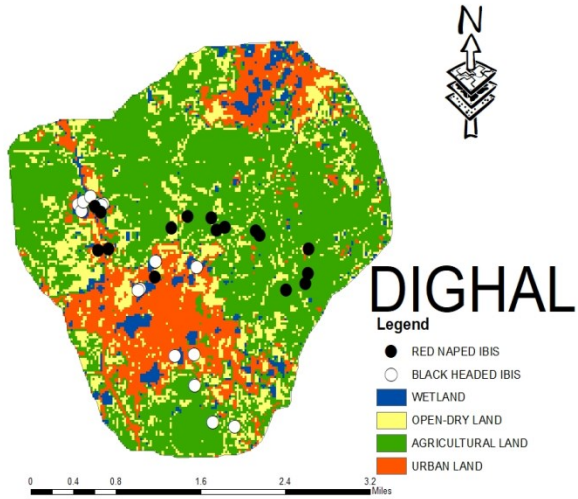


Figure 3- Land cover map predicting Black Headed Ibis and Red Naped Ibis sightings in village Dighal.

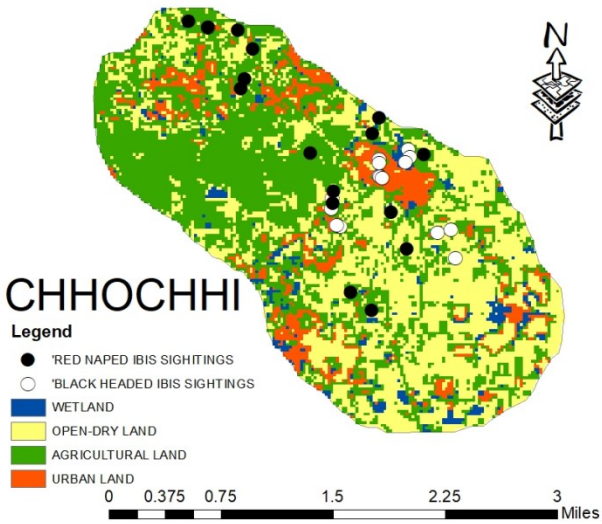


Figure 4- Land cover map predicting Black Headed Ibis and Red Naped Ibis sightings in village Chhochhi.

"It is in humility that we build the future of the world"

IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI; PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org

ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27
DOI: http://doi.org/10.5281/zenodo.5596613

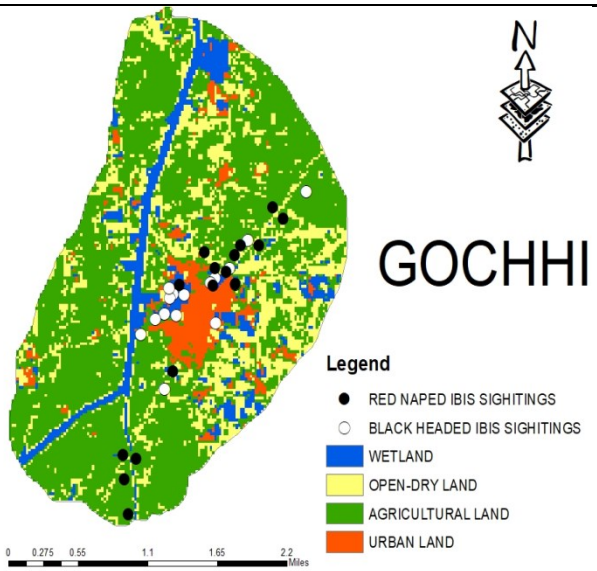


Figure 5- Land cover map predicting Black Headed Ibis and Red Naped Ibis sightings in village Gochhi.

Figure 6- Black Headed Ibis sighted at wetland habitat.

Figure 7- Black Headed Ibis sighted at agricultural land area.

"It is in humility that we build the future of the world"
IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI: PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org
United Nations Educational, Scientific and Cultural Organization
ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27
DOI: http://doi.org/10.5281/zenodo.5596613

Figure 8- Red Naped Ibis sighted at agricultural habitat.

Figure 9- Red Naped Ibis sighted at open-dry land area.

Table 1. Habitat variables in three different habitats of the study sites

| Sr. No. | Habitat type | Habitat usage | Dominant Microhabitat Variables | Major Dominant vegetation | Percentage of Black Headed Ibis Spotted | Percentage of Red Naped Ibis Spotted |
|---|---|---|---|---|---|---|
| **1** | Wetland | Foraging and Roosting | *Eichhornia, Vallisneria, Hydrilla, Saccharum bengalense, Datura stramonium, Cannabis sativa, Ficus religosa Calotropis procera, Azadirachta indica, Vachellia nilotica, Eucalyptus globules* and *Acacia nilotica* | Aquatic plants, trees and grasses | 60.41% | 08.33% |
| **2** | Open-dry land | Foraging | *Parthenium hysterophorous,Cynodon dactylon, Calotropis procera, Datura stramonium, Saccharum bengalense, Eucalyptus globules* and *Acacia nilotica* | Trees and grasses | 16.66% | 41.66% |
| **3** | Agricultural land | Foraging and Roosting | *Triticum aestivum, Saccharum officinarum, Brassica, Psidium guajava, Ficus religosa, Citrus limon, Azadirachta indica, Vachellia nilotica, Eucalyptus globules* and *Acacia nilotica* | Seasonal crops and trees | 22.91% | 50.00% |

"It is in humility that we build the future of the world"
IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI: PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org
United Nations Educational, Scientific and Cultural Organization
ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27
DOI: http://doi.org/10.5281/zenodo.5596613

## DISCUSSIONS

During the study, 48 spotting of both the Ibis species were observed in three different habitats named as wetland, open-dry land and agricultural land area. Black Headed Ibis was found to be greater in wetland habitat (60.41%) among three different habitats which were observed to be slightly smaller in the agricultural land and open-dry land as it is a wading bird species which always prefer to inhabiting the area having shallow water (1,2,10). While Red Naped Ibis also belongs to waders but was found to be maximum in agricultural land area (50%) followed by open-dry land (41.66%) and wetland (26).

In our study, habitat preference by the Black Headed Ibis was seen to be changing seasonally, which remains quit same in case of Red Naped Ibis fluctuating in between agricultural land and open-dry land; reveals that the preference of habitat was a function foraging and survival decisions of an organism (27). Our study revealed that along with the perennial wetland Black Headed Ibis was also reported to inhabiting the seasonal wetlands and the agricultural land filled with standing water because of the availability of larger amount of food materials in the form of larger open marshland in these seasonal wetlands and agricultural land area (21). While Red Naped Ibis was majorly reported feeding from the agricultural land area and open-dry land areas near the water bodies as it removes majority of insects from that ecosystem by feeding upon them and also known as "Farmer's Friend" (26).

During our study period Black Headed Ibis was also reported from the sewage line area as the amount of chironomid larvae and oligochaetes always found to be higher in these areas (2,28,29,30). As revealed earlier that for nesting and roosting habitat both of them prefer a habitat near the wetland areas (2,16), on the top of trees and bushes, like *Acacia*, *Prosopis* and *Ficus* (2,17). But during our study no nesting was observed only roosting of both the species were observed. Out of the two, Black Headed Ibis was always observed roosting in colonies of more than two species, belonging from Ciconiiform and Pelecaniform orders near the wetland areas (16) while roosting of Red Naped Ibis was never observed in colonies, on the top of the trees namely *Eucalyptus globules* and *Acacia nilotica* near the agricultural land area not near the wetland areas.

As this Near Threatened species Black Headed Ibis require some conservation efforts, our study on the habitat selection of Black Headed Ibis and Red Naped Ibis provides a significant information regarding the conservation of habitat which ultimately helps in conserving the species in our study site.

## ACKNOWLEDGEMENT

The author wish to thank the Council of Scientific & Industrial Research (CSIR) for providing financial support needed to carry out the research work. We also want to thanks, Chairperson, Department of Zoology, Kurukshetra University, Kurukshetra for providing necessary facilities to carry out this present study. We also like to thank Mr. Harsh Gulati, Mr. Amit Kumar and Ms Parul Research Scholars for their support in data collection.

## References-

[1] Hancock, J.A., Kushlan, J.A.,& Kahl, M.P. (2001).
*Storks, Ibises and Spoonbills of the world.* Academic Press, London.

[2] Chaudhury, S., & Koli, V. K. (2018). Population status,
habitat preference, and nesting characteristics of Black-headed Ibis (*Threskiornis melanocephalus*) (Latham, 1790) in southern Rajasthan, India. *Journal of Asia-Pacific Biodiversity*, *11*(2), 223-228.

"It is in humility that we build the future of the world"
IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI: PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org
United Nations Educational, Scientific and Cultural Organization
ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27
DOI: http://doi.org/10.5281/zenodo.5596613

[3] Sibley, C. G., & Ahlquist, J. E. (1972). *A comparative study of the egg white proteins of non-passerine birds* (Vol. 39). Peabody Museum of Natural History, Yale University Press, New Haven, Connecticut.

[4] Eisenmann, E., Mayr, E., & Parkes, K. (1984). Threskiornithidae Richmond, 1917 (Aves): application to place on official list of family-group names in zoology and to give precedence over Plataleinae Bonaparte, 1838, and other competing family-group names. *Bulletin of zoological nomenclature*, *41*(4), 240-244.

[5] IUCN. (2016). The IUCN Red List of Threatened Species. Version 2016-3. Available at: www.iucnredlist.org. (Accessed: 07 December 2016).

[6] Kushlan, J.A. (1978a). *Feeding ecology of wading birds*. National Audubon Society, New York.

[7] Manakadan, R., Daniel, J. C., Bhopale, N., & Dick, J. H. (2012). *Birds of the Indian Subcontinent: A Field Guide Based on Sálim Ali & Dillon Ripley's" pictorial Guide"*. Bombay Natural History Society.

[8] Whittaker, R. H., Levin, S. A., & Root, R. B. (1973). Niche, habitat, and ecotope. *The American Naturalist*, *107*(955), 321-338.

[9] Luo, K., Wu, Z., Bai, H., & Wang, Z. (2019). Bird diversity and waterbird habitat preferences in relation to wetland restoration at Dianchi Lake, south-west China. *Avian Research*, *10*(1), 1-12.

[10] Ali, S., & Ripley, S. D., (2007). *Handbook of Birds of India and Pakistan.* (2nd ed.). Oxford University Press, New Delhi.

[11] BirdLife International. (2012). *Threskiornis melanocephalus*. The IUCN Red List of Threatened Species 2012. e.T22697516A37830989. Available at: https://doi.org/ 10.2305/IUCN.UK.2012-1.RLTS.T22697516A37830989.en [Date accessed: 16 September 2016].

[12] BirdLife International. (2016). *Threskiornis melanocephalus.* The IUCN Red List of Threatened Species 2016: e.T22697516A93618317. Available at: http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22697516A93618317.en

[13]BirdLife International. (2016). *Pseudibis papillosa.* The IUCN Red List of Threatened Species 2016: e.T22697528A93619283. Available at: http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22697528A93619283.en

[14] Thapa, J. B., & Saund, T. B. (2012). Water quality parameters and bird diversity in Jagdishpur Reservoir, Nepal. *Nepal Journal of Science and Technology*, *13*(1), 143-155.

[15] Paliwal, G.T., & Bhandarkar, S.V. (2017). Ecology and Conservation of Threatened Birds in and around Navegaon National Park, Maharashtra. *Essence - International Journal for Environmental Rehabilitation and Conservation*, *1*,120-135.

[16] Balakrishnan, M., & Thomas, S. K. (2004). Conserving the breeding habitat of the near threatened Oriental White ibis (*Threskiornis melanocephalus*). *Current Science*, *87*(9), 1190-1192.

[17] Senma, R. C., & Acharya, C. A. (2009). Nest and nest contents of near threatend Black Headed Ibis (*Thriskiornis melanocephalus*). *Asian Journal of Animal Science*, *4*(2), 146-148.

[18] Beauchamp, G. (1999). The evolution of communal roosting in birds: origin and secondary losses. *Behavioral Ecology*, *10*(6), 675-687.

[19] Laughlin, A. J., Sheldon, D. R., Winkler, D. W., & Taylor, C. M. (2014). Behavioral drivers of communal roosting in a songbird: a combined theoretical and empirical approach. *Behavioral ecology*, *25*(4), 734-743.

[21] Chaudhary, S. (2018). *Study on the distribution, ecology and ethology of Black-headed Ibis (Threskiornis melanocephalus) in southern Rajasthan.* Ph.D. Thesis, Mohanlal Sukhadia University, Udaipur, Rajasthan, India.

[22] McGarigal, K., Cushman, S.A., Neel, M.C., and Ene, E. (2002). Fragstats: Spatial Pattern Analysis Program for Categorical Maps. Computer software program produced by the authors at

IJBST Journal Group
The IJBST Journal Group is non-discriminatory, apolitical, diversity inclusive, ethical, serves with integrity & compassion
Open Access, Free, Peer-Reviewed, Non-Profit
EBSCO, PROQUEST, CABI, ROAD Indexed
ZENODO DOI: PUBLONS Verified
UNESCO MIL Alliance Member
www.ijbst.org
United Nations Educational, Scientific and Cultural Organization
ISSN: 0974 – 3987
IJBST (2021), 14(2): 18-27
DOI: http://doi.org/10.5281/zenodo.5596613

the University of Massachusetts, Amherst, available at the following web site:http://www.umass.edu/landeco/research/fragstats/fragstats.html.

[23] McGarigal, K., Cushman, S.A., Neel, M.C., and Ene, E.
(2012). Fragstats: Spatial Pattern Analysis Program for Categorical and Continuous Maps. Computer software program produced by the authors at the University of Massachusetts, Amherst. Available at the following web site: http://www.umass.edu/landeco/research/fragstats/fragstats.html

[24] Noon, B. R. (1981). Techniques for sampling avian
habitats. *The use of multivariate statistics in studies of willife habitat. USDA For. Ser. Gen. Tech. Rep. RM-87*, 42-52.

[25] Bibby C.J., Burgess N.D., Hill D.A. & Mustoe S.H.,
(1992). *Bird Census Techniques.* Academic Press, London.

[26] Rajesh & Kumar, M. (2017). Abundance and feeding ecology of Black Ibis (*Pseudibis papillosa)* in agricultural fields of Punjab, India. *Journal of Entomology and Zoology Studies, 5*(4), 992-995.

[27] Rosenzweig, M. L. (1981). A theory of habitat selection. *Ecology, 62*(2), 327-335.

[28] Frederick, P. C., & Bildstein, K. L. (1992). Foraging
ecology of seven species of neotropical Ibises (Threskiornithidae) during the dry season in the Llanos of Venezuela. *Wilson Bulletin, 104*(1), 1-21.

[29] Safran, R. J., Colwell, M. A., Isola, C. R., & Taft, O. E.
(2000). Foraging site selection by nonbreeding White-faced Ibis. *The Condor, 102*(1), 211-215.

[30] Sundar, K. G. (2006). Flock size, density and habitat
selection of four large waterbirds species in an agricultural landscape in Uttar Pradesh, India: Implications for management. *Waterbirds, 29*(3), 365-374.